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Inventory of phytoplanktonic taxa in three Moroccan dam reservoirs (Med Ben Abdelkrim Al Khattabi, El Kansera and Mansour Ed Dahbi)

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ABSTRACT

This study is conducted on the evolution of the phytoplankton population in three selected Moroccan dams (Med Ben Abdelkrim Al Khattabi, El Kansera and Mansour Ed Dahbi) over a period of ten years (2000-2010). As results, the phytoplankton inventory in these dams has shown 63 taxa. The vast majority of species belongs to the family of Chlorophyceae, then the diatoms and Cyanophyceae. The others taxa as the species of Dinophycea, Cryptophyceae and Euglophyceae are underrepresented. The other systematic groups (Dinophyceae, Cryptophyceae, and Euglophyceae) are poorly taxonomically represented. Similarly, the family of chlorophyceae is the richest of genus. This systematic structure of the phytoplankton stand is different from those noted in the hydrosystems of Tunisia and Corsica.

Key words – Phytoplankton, taxonomic structure, dams, Morocco.

INTRODUCTION

In the lake ecosystems, the phytoplankton occupies an important trophic position and, therefore, a crucial element in their operation. Indeed, any qualitative or quantitative variation of this basic compartment causes fluctuations of the operation of the food webs. Likewise, significant fluctuations in the distribution, composition, and abundance of algal populations are governed by physical, chemical and biological factors that characterize the environment (Berrada et al., 2000; Blasco et al., 1980).

In addition, many researches that has been done on the Moroccan lake environments concern the hydrological study of the fauna (macroinvertebrates, fish) (Lamri et Belghyti, 2011; Berrahou et al., 2011; Ben Moussa et al., 2014), but little or no those concern phytoplankton. So, to better understand the operation of water systems, it is necessary to develop the research area dealing with the structure and ecology of their phytoplanktonic stands.

Thus, this work aims to inventory the different taxa of the phytoplankton of three dam reservoirs which are spread along the north-south axis of Moroccan territory, (Ben Mohamed Abd el-Krim, and Kansera El Mansour Eddahbi) over ten years (2000-2010).

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MATERIALS AND METHODS

Study circles

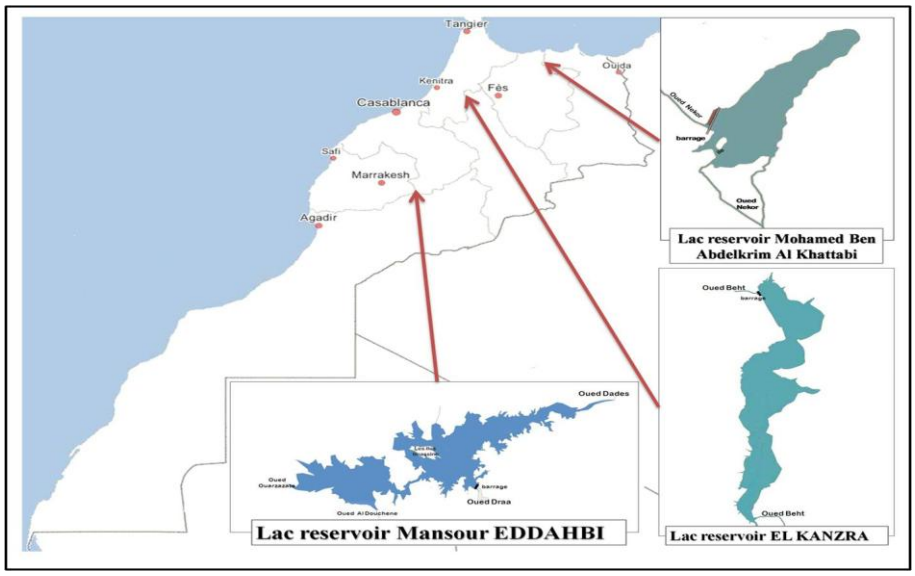
The phytoplankton samples were collected on three selected Moroccans dams; Sidi Mohammed Ben Abd el-Krim, EL Kansera, and Mansour Eddahbi. Table-1 shows the main characteristics of these reservoirs studied (ONEP, 1996), and Figure-1 shows the geographic location of each of them.

The dam retaining El Kansera is one of the oldest

Table-1. Characteristics of the studied dam deductions (ONEP, 1996)

Restraint name (former name)	Year of commissioning (Year of elevation)	Closest town	Watercourse		Dam		The destination of drinking water
			Name	Mean annual flow (m^3/ s)	Water surface of the dam (km^2)	Volume (million m^3)	
Sidi Md Ben abdekarim el Khattabi	1981	Al Hoceima	Nekor	2.95	3.86	43.3	Al Hoceima
EL Kansera	1935 (1969)	Sidi Slimane	Beht	12	18.20	290	Tifelt - Khemissét
Mansour Eddahbi	1972	Ouarzazate	Draa	13.4	48.80	566.9	Ouarzazate

Figure-1. Geographic location of the studied dams



Barrage Sidi Mohamed Ben Abd el-Krim (BEMAK):

The catchment area of Nekor, located in the northeast of Morocco and in the eastern part of the Rif mountains (between 35 ° latitudes 43 'and 35 ° 6' North and between longitudes 3 ° 36 'and 4 ° o) opens on the Mediterranean Sea by a broad alluvial plain in the east of the city of Al Hoceima. The Nekor watershed includes mountains of 1000 meters to more than 1500 m. The most accused Relief is on the eastern watershed in Azrou-Akechou (2009 m altitude) (Lahlou, 1990).

The climate is characterized by a wet period (Winter) which extends from October to May and received the maximum rainfall, and a dry and warm period (summer) from June to September. Furthermore in all Mediterranean countries, precipitation exhibit high interannual irregularity.

Barrage El Kansera:

dams of Morocco; it was built in 1935, it is located in the northwest of the country in the basin Beht, and it provides a support for the low water and the clips the flooding of the wadi Beht last major tributary of the Sebou River. The water contributions of the Beht river are particularly eutrophic because they carry raw sewage from the city of Khemisset located immediately upstream of the reservoir. A significant deterioration of the water quality of Lake's tank is well observed since the impoundment of the dam (ONEP, 1996). The hydro-morphometric features of this withholding ecosystem lake are particularly the same applied in the study of flat bottom tanks under warm Mediterranean climate (Derraz, 1995).

Barrage Mansour Eddahbi:

The Ouarzazate basin is the upstream part of the great basin of the Oued Draa. It holds about 7% of groundwater resources of Morocco (Agoussine et

Bouchaou, 2004). The dam of restraint is in the central part of the groove that is individualized between the High and Anti-Atlas. It is bounded to the north by the South Atlas Accident and the Precambrian outcrops of

Table-2. Frequency and plankton sampling period

Name of the dam	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sidi Md Ben Abdekarim el Khattabi	1	3	3	2	4	2	1	3	4	2	1
EL Kansera	3	2	5	4	4	1	3	5	4	3	2
Mansour Eddahbi	1	3	2	4	1	2	2	2	3	-	-

Table-3: Inventory of phytoplankton species harvested in the three dam reservoirs levels

	Taxa	Dam of El Kansera	Dam of Mbaek	Dam of Mansour Eddahbi
Chlorophyceae	*Ankistrodesmus convolutes*	-	-	+
	Ankistrodesmus falcatus	-	+	+
	Ankistrodesmus falcatus v.acic	-	-	+
	Ankyra judai	-	+	+
	Botryococcus braunii	+	+	+
	Carteria cordiformis	+	-	+
	Chlorella sp	-	+	-
	Closterium aciculare	+	+	+
	Closterium aciculare var.subpronum	+	-	+
	Closterium sp	+	+	-
	Coelastrum microporum	-	-	+
	Coelastrum reticulatum	+	+	+
	Cosmarium leave	+	+	+
	Cosmarium punctulatum	-	-	+
	Elakatothrix gelatinosa	-	+	+
	Oocystis borgei	+	-	+
	Oocystis crassa	+	+	+
	Oocystis lacustris	+	+	+
	Oocystis sp	-	-	+
	Pediastrum duplex	+	+	-
	Pediastrum ovatum	+	-	-
	Pediastrum simplex	+	-	-
	Pediastrum simplex var.duodenarium	+	-	-
	Pediastrum sp	-	+	-
	Phacotus lenticularis	+	-	-
	Scenedesmus arcuatus	-	-	+
	Scenedesmus bijugatus	+	+	+
	Scenedesmus obliquus	+	+	+
	Scenedesmus quadricauda	+	-	+
	Schroederia sp	+	-	-
	Staurastrum pingue	+	-	+
	Staurastrum sp	+	-	-
	Tetraedron minimum	-	+	+

	Taxa	Dam of El Kansera	Dam of Mbaek	Dam of Mansour Eddahbi
Diatoms	*Cocconeis sp*	-	+	-
	Coscinodiscus sp	+	+	+
	Cyclotella sp	+	+	+
	Cymbella sp	+	-	+
	Girosigma sp	+	+	-
	Gomphonema sp	-	+	-
	Melosira granulate	+	+	-
	Navicula sp	+	+	+
	Nitzschia acicularis	+	+	+
	Nitzschia sp	+	+	+
	Synedra acus	+	+	-
	Synedra sp	+	+	+
	Synedra ulna 1 3	+	+	+
Cyanophyceae	*Aphanisomenon sp*	+	-	+
	Chroococcus sp	+	+	+
	Chroococcus turgidus	-	+	-
	Lyngbya limnetica	-	+	+
	Lyngbya sp	+	+	+
	Merismopedia sp	+	-	-
	Microcystis aeruginosa	+	-	-
	Microcystis sp	+	-	+
	Oscillatoria sp 9	+	+	+
Dinophycea e	*Ceratium hirundinella*	+	+	+
	Peridinium cinctum	+	+	+
	Peridinium sp	-	+	+
Cryptophyceae	*Chroomonas sp*	+	-	-
	Cryptomonas sp	+	+	+
	Dinobryon sp 3	-	-	+
Euglenophyceae	*Euglena sp*	+	+	+
	Phacus sp 2	-	+	+

the Anti-Atlas south (buttonhole Saghro). It has a relatively narrow watershed (about 160 km long and a maximum width of 45 km at Ouarzazate and Skoura). The altitude is between 1100 m and 1500 m. The center of the basin, filled by Neogene and Quaternary sediments forms a notched plain by some wadis (Jossen et Filali Moutei, 1998). The study area is characterized by an arid climate, having a dry continental trend (Sadani et al., 2003).

Sampling techniques

The samples were taken by the central laboratory of monitoring of water quality (ONEP). Water samples are taken, according to a defined schedule (Table 2), using a plankton net 20 mm empty mesh, or using a sample bottle (or Friedinger Ruttner) for the depth sampling. The planktonic samples were kept plactonique using the lugol at low temperature (about 4 ° C) to the laboratory where it is stored at room temperature. The analysis and identification of the phytoplanktonic taxa were performed in accordance with the recommendations of the standard guide for the enumeration of phytoplankton by

inverted microscope, NF EN 15204 for the method Utermöhl (1958) using the key determination Bourrelly (1972 1981 and 1985). The method of the cell, used in this study count, is a statistical method which is based on a random distribution of organisms in the sediment. It consists of a random selection of surfaces or delimited fields in the sediment by the image of a grid mounted in the eyepiece (Gille Whipple). Knowing the field surface, the surface of the chamber, the number of examined fields and concentrate volume, a conversion factor is calculated for expression of the result in a number of organisms per unit volume. The precision is so much greater than the number of fields prospected or concentrate volume are large and therefore, the conversion factor is lower. After measuring the cell size and calculating cell volume, the count result is converted into cell weight (biomass) using the relationship between cell volume and weight ($10^6 \mu m^3$ correspond to 1 µg).

The following table shows the frequency and plankton sampling period in reservoirs of dams studied.

RESULTS AND DISCUSSION

Inventory of phytoplanktonic species or taxa:

The analysis of samples has allowed identifying 63 taxa in total, of which 48 taxa are listed at the dam EL Kansera, 44 at the Mansour Eddahbi dam, and 39 at the dam Mohammed bin Abdelkarim El Khattabi (MBAEK) (Table-3).

This phytoplankton inventory carried out at the level of 3 lake ecosystems, belonging to different bioclimatic stages, shows a quite diverse specific composition.

The taxonomic structure of the listed phytoplankton is well diversified with 61 taxa in total, 45 taxa in El Kasra, 42 taxa in the MBAEK dam and 44 taxa in the Mansour Eddahbi dam.

The family of Chlorophycea is taxonomically the richest: 33 taxons in total, 22 taxa in El Kasra, 16 taxa in the dam MBAEK and 16 taxa in the dam Mansour Eddahbi. Then, Diatoms: 1 3 taxa in total, 11 taxa in El Kasra, 12 taxa in the MBAEK dam and 7 taxa in the Mansour Eddahbi dam, and the Cyanophyceae, with 8 identified taxa including 7 in El Kasra, 5 in the MBAEK dam and 5 to the Mansour Eddahbi dam. Finally, the families of Dinophyceae, Cryptophyceae and Euglenophyceae are poorly represented; respectively, for each of them, less than 7 taxa per dam were inventoried.

Similarly, as shown in Table 4, the family of Chlorophyceae is richer in genus: 21 genres in El Kasra, 16 genres in the MBAEK dam and 23 genres in the Mansour dam Eddahbi. For the Cyanophyceae, 11 genres at El Kasra, 12 Genres at the MBAEK dam and 8 Genes at the Mansour Eddahbi dam. For the other families, the diversity of genres is low in the three dams.

It should be noted that this structure of the phytoplanktonic stand noted in the studied media is very different from that reported by Ayadi et al. (2002) about the structure of the phytoplankton stands of the salinas in Sfax's region (Tunisia) which were characterized by the dominance of diatoms instead of chlorophytes in the primary saline basins, followed by dominance of dinoflagellates in the intermediate basins, and a quasi-mono-specific development of chlorophytes in the saline basins. In Corsica, the structure results obtained in the summer study by Tolomio (2011) on the summer phytoplankton stand of the Bay of Calvi and Gulf of Porto Vecchio, has shown Diatoms dominate, followed by Dinophyceae.

Table 4: Number of the systematic families identified in the three dams

-	El Kansera	MBAEK	Mansour Eddahbi	Total
Chlorophyceae	21	16	23	60
Cyanophyceae	11	12	8	31
Cyanophyceae	7	5	6	18
Dinophyceae	6	3	3	12
Cryptophyceae	2	1	2	5
Euglenophyceae	1	2	2	5
Total	48	39	44	131

On the other hand, this taxonomic difference in the structure of the phytoplankton population from one medium to another is a consequence of the action of the medium itself on the taxa. Indeed, since the distribution of organisms colonizing aquatic environments is mainly dictated by self-ecological processes (Dolédec et al., 1999), the difference in biocenosis structure from one environment to another is linked to ecological conditions Offered by their environment. In addition, anthropogenic disturbances have a strong impact on aquatic biodiversity (Sweeney et al., 2004). Changes in communities may result directly from the introduction and/or disappearance of species induced more or less directly by human activities (Bollache et al., 2004).

CONCLUSION

In the studied dams, the specific composition of phytoplankton is quite diverse (61 taxa) and group Chlorophyceae, Cyanophyceae, Dinophyceae, Cryptophyceae, and Euglenophyceae. The total number of taxa per dam does not vary much: 45 taxa in El Kasra, 42 taxa in the MBAEK dam and 44 taxa in the Mansour Eddahbi dam. The Chlorophyceae family is taxonomically the richest (33 taxa in total) and the Cyanophyceae (8 taxa). The other families are systematically less abundant.

Moreover, in the three dams, the Chlorophyceae is the richest of genus and it is the Barrage Mansour Eddahbi which has 23. For the Cyanophyceae, 31 genera and it is the MBAEK dam which in 12.

It should be noted that in the three dams studied the taxonomic structure of the phytoplankton population is

different from those reported in other hydrosytems such as those reported in the Salt Sfax and the waters of the Bay of Calvi and Gulf of Porto Vecchio in Sardinia where the Diatoms predominate, followed by the Dinophyceae. The ecological conditions specific to each environment and the anthropogenic action could be the main causes of this difference.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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